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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/714,207	11/14/2003	Yuan-Hung Chiu	TS03-442	2547

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HAYNES AND BOONE, LLP  
901 MAIN STREET, SUITE 3100  
DALLAS, TX 75202

EXAMINER

TRINH, MICHAEL MANH

ART UNIT PAPER NUMBER

2822

DATE MAILED: 01/10/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

<b>Office Action Summary</b>	<b>Application No.</b> 10/714,207	<b>Applicant(s)</b> CHIU ET AL.	
	<b>Examiner</b> Michael Trinh	<b>Art Unit</b> 2822	

**-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --**

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 20 October 2005.
- 2a) ☒ This action is **FINAL**.                      2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-11,13-19,21-29 and 31-39 is/are pending in the application.
- 4a) Of the above claim(s) 11,13-19,21-29 and 31-39 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-10 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |  |   |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892)   | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                                   | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____  |

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## DETAILED ACTION

\*\*\* This office action is in response to Applicant's Amendment filed October 20, 2005.

Claims 1-11,13-19,21-29, and 31-39 are pending. Claims 12,20 and 30 were canceled.

\*\*\* The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

### *Election/Restrictions*

1. This application contains claims 11,13-19,21-29,31-39 withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a nonelected invention, with traverse, there being no allowable generic or linking claim. A complete reply to the final rejection must include cancellation of nonelected claims or other appropriate action (37 CFR 1.144) See MPEP § 821.01.

### *Claim Rejections - 35 USC § 102*

2. Claims 1,5 are rejected under 35 U.S.C. 102(b) as being anticipated by Yeh et al (6,207,565).

Yeh et al teach an integrated process flow involving a patterned photoresist layer 208 on a substrate 102 in an etching tool that has one or more process chambers, said patterned photoresist layer 208 having an opening with a top and bottom that extends through at least one underlying layer 104 in said substrate 102, comprising: (a) performing an oxygen ashing step to remove said patterned photoresist layer 208 (Figs 9, col 6, lines 47-55; col 2, lines 38-54; col 1, lines 35-53); (b) cleaning a residue from the opening by performing a halogen containing plasma step, in which oxide etch by using a dry plasma etch, such as CF<sub>4</sub>, to remove the oxide that grew onto the semiconductor substrate (col 6, lines 56 through col 7; Fig 9; col 2, lines 38-54; col 1, lines 35-53) ; and (c) after dry plasma etch to clean the residues, etching the cleaned opening in the substrate by performing a CF<sub>4</sub>/H<sub>2</sub>O plasma in the substrate (col 6, line 64 through col 7; Fig 9). Re claim 5, wherein the halogen containing plasma step involves a plasma of CF<sub>4</sub>, CHF<sub>3</sub>, C<sub>2</sub>F<sub>6</sub>, which plasma satisfies C<sub>x</sub>F<sub>y</sub>H<sub>z</sub> where x and y are integers and z is an integer or is 0 (col 6, lines 56-63; col 7, lines 22-25).

***Claim Rejections - 35 USC § 103***

3. Claims 1, 5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chen et al (6,025,273) in view of Yeh et al (6,207,565).

Chen teaches an integrated process flow involving a patterned photoresist layer 18 on a substrate 12/10 in an etching tool that has one or more process chambers, said patterned photoresist layer 18 having an opening with a top and bottom that extends through at least one underlying layer 16 in said substrate, comprising: (a) performing an oxygen ashing step to remove said patterned photoresist layer 18 (Figs 3-4; col 4, lines 51-65); and (c) etching the opening in the substrate to transfer the opening through an exposed layer at the bottom of the opening in said substrate (Fig 5, col 5, lines 1-20). Re claim 5, wherein said halogen containing plasma step involves a plasma of  $\text{CF}_4$ ,  $\text{CHF}_3$ ,  $\text{C}_2\text{F}_6$ , which plasma satisfies  $\text{C}_x\text{F}_y\text{H}_z$ , where x and y are integers and z is an integer or is 0 (col 4, lines 64 through col 5, line 5).

Re claim 1, Chen lacks cleaning a residue from the opening by performing a halogen containing plasma after oxygen ashing to remove the photoresist layer.

However, Yeh teaches (at col 6, lines 38 through col 7; Fig 9; col 2, lines 38-54; col 1, lines 35-53) cleaning to remove residues from the opening by performing a halogen containing plasma after oxygen ashing to remove the photoresist layer, since residues are existed on the substrate.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to fabricate the semiconductor process flow involving a patterned photoresist layer of Chen by performing a halogen containing plasma to clean and remove residues from the opening after oxygen ashing to remove the photoresist layer, as taught by Yeh. This is because of the desirability to clean and remove residues from the substrate. This is also because of the desirability to prepare a semiconductor substrate which does not allow residues to become trapped on the semiconductor substrate so that other subsequent processes can be surely carried out in a reliable manner, thereby a high quality semiconductor device can be effectively manufactured.

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4. Claim 2 is rejected under 35 U.S.C. 103(a) as being unpatentable over Chen et al (6,025,273) and Yeh (6,207,565), as applied to claims 1,5 above, taken with Shan et al (6,232,236) and Levenson et al (2001/0038089).

The references including Chen and Yeh teach an integrated process flow involving a patterned photoresist layer 18 as applied to claims 1 and 5 above.

Re claim 2, the references including Chen lacks listing etching tool being a split power etcher, a dual power etcher, a single power etch tool, a reactive ion etcher, or a conventional barrel, direct, or downstream type of ashing tool.

However, Shan teaches (at col 5, lines 11-29; col 3, lines 46-55; col 4, lines 15-35) etching tool including a split power etcher, a dual power etcher, a single power etch tool, a reactive ion etcher. Levenson teaches (at col 4, paragraph 46; paragraphs 5-12) plasma ashing tool including down flow, barrel, direct, and downstream type of ashing tool. Chen also teaches (at col 4, lines 55-67) the etching tool including reactive ion etching (RIE) or a HDP etcher.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to perform the oxygen ashing and halogen plasma step of Chen by employing the etching tool of a split power etcher, a dual power etcher, a single power etch tool, a reactive ion etcher, or a barrel, direct, or downstream type of ashing tool, as taught by Shan and Levenson. This is because these tools are alternative and art recognized equivalent tools so that the plasma ashing and etching steps can be effectively performed in a reliable manner.

5. Claim 3-4 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chen et al (6,025,273) and Yeh (6,207,565), as applied to claims 1,5 above, taken with Applicant's admitted prior art (present specification page 1).

The references including Chen and Yeh teach an integrated process flow involving a patterned photoresist layer 18 as applied to claims 1 and 5 above. Chen teaches (at col 4, lines 55-67) the etching tool including reactive ion etching (RIE) or a HDP etcher.

Re claims 2-3, the references including Chen lack explicitly mentioning to perform the steps in the same process chamber of the etching tool.

However, Applicant's admitted prior art teaches (at present specification page 1, last paragraph) to perform the ashing and etching steps in the same process chamber of the etching tool.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to perform the steps of oxygen ashing, halogen plasma, and transfer of Chen in the same process chamber of the etching tool. This is at least because of the desirability to reduce production and equipment cost and processing time, since only a tool is needed.

6. Claim 5-6 are further rejected under 35 U.S.C. 103(a) as being unpatentable over Chen et al (6,025,273) and Yeh (6,207,565), as applied to claims 1,5 above, taken with Hayasaka et al (5,298,112) and Hori et al (5,411,631).

The references including Chen and Yeh teach an integrated process flow involving a patterned photoresist layer 18 as applied to claims 1 and 5 above. Re claims 5-6, Chen already teaches (at col 4, lines 58 through col 5, line 5) halogen containing plasma including  $\text{Cl}_2$ ,  $\text{HBr}$ ,  $\text{CF}_4$ .

The references including Chen do not list all halogen plasma as recited in claim 5, the plasma includes  $\text{CF}_4$ ,  $\text{CH}_2\text{F}_2$ ,  $\text{SF}_6$ ,  $\text{NF}_3$ ,  $\text{Cl}_2$  and  $\text{C}_x\text{F}_y\text{H}_z$  where x and y are integers and z is an integer or is 0; and Re claim 6,  $\text{HBr}$  is included in combination with the above halogen plasma.

However, Hori teaches (at col 5, lines 36-54) halogen containing plasma including  $\text{CF}_4$ ,  $\text{NF}_3$ ,  $\text{SF}_6$ ,  $\text{Cl}_2$ ,  $\text{CHF}_3$ , in which  $\text{C}_x\text{F}_y\text{H}_z$  where x and y are integers and z is an integer or is 0, wherein  $\text{HBr}$  is included in combination with the plasma including  $\text{Cl}_2$ . Chen already teaches (at col 4, lines 58 through col 5, line 5) halogen containing plasma including  $\text{Cl}_2$ ,  $\text{HBr}$ ,  $\text{CF}_4$ .

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to perform the halogen containing plasma step of Chen by employing available known halogen containing plasma including of  $\text{CF}_4$ ,  $\text{CH}_2\text{F}_2$ ,  $\text{SF}_6$ ,  $\text{NF}_3$ ,  $\text{Cl}_2$  and  $\text{C}_x\text{F}_y\text{H}_z$  where x and y are integers and z is an integer or is 0, with  $\text{HBr}$  included in the halogen plasma, as taught by Hori and Chen. This is because these halogen containing plasma are alternative and art recognized equivalent plasma etchants so that unwanted residues and material can be effectively removed from the substrate in a reliable manner.

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7. Claims 7-8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chen et al (6,025,273) and Yeh (6,207,565), as applied to claims 1,5 above, taken with Webb et al (5,228,950).

The references including Chen and Yeh teach an integrated process flow involving a patterned photoresist layer 18 as applied to claims 1 and 5 above.

Re claims 7-8, Chen already teaches (at col 4, lines 55-67) using reactive ion etching (RIE) or a HDP etcher for performing the halogen containing plasma step, but lacks detail about process parameters of flow rate, pressure, temperature, power, time period, as recited in claims 7-8.

However, Yeh also teaches (at Fig 6, Table I, Step 2) performing a halogen containing plasma step, with a gas flow rate of about 360 standard cubic centimeters per minute (sccm), a chamber pressure about 0.5 Torr, a chamber temperature of about 250 degree C, a RF power of about 975 Watts, and for a period of less than about 2 seconds. Webb teaches (at col 3, line 9 through col 4, lines 60) performing a NH<sub>3</sub>-halogen containing plasma step, with a gas flow rate of about 10-500 standard cubic centimeters per minute (sccm; col 3, lines 23-40), a chamber pressure about 20 milliTorr to about 1 Torr (col 3, lines 9-22), a chamber temperature of about 25 to 150 degree C, a RF power ranging of about 50-400 Watts, and for a period of about 5-60 seconds (col 4, lines 1-5, 51-60).

Therefore, the subject matter as a whole would have been obvious to one of ordinary skill in the art at the time the invention was made to select the portion of the prior art's range flow rate, temperature, a RF power ranging for top RF power and bias RF power, pressure, time period, etc., as taught by Yeh and Webb, and known in the art, which is within the range of applicant's claims, because it has been held to be obvious to select a value in a known range by optimization for the best results, and would be an unpatentable modification, where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation". *In Re Aller* 104 USPQ 233,255 (CCPA 1955); *In re Waite* 77 USPQ 586 (CCPA 1948); *In Re Swanson* 56 USPQ 372 (CCPA 1942); *In Re Sola* 25 USPQ 433 (CCPA 1935); and *In Re Dreyfus* 24 USPQ 52 (CCPA 1934).

8. Claims 9-10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chen et al (6,025,273) and Yeh (6,207,565), as applied to claims 1,5 above, taken with Verhaverbeke et al (2003/0045098).

The references including Chen and Yeh teach an integrated process flow involving a patterned photoresist layer 18 as applied to claims 1 and 5 above.

The references including Chen already teaches using the patterned photoresist layer 18 during semiconductor fabrication, wherein, the opening exposes an underlying silicon layer 12 and step (c) forms a shallow trench in the silicon layer 12 (Figs 7,5; col 5, lines 1-49).

Chen thus lacks mentioning his method for forming a shallow trench in the substrate (claim 9); and for forming a gate electrode (claim 10).

However, Verhaverbeke teaches (at Figs 16A-16C) applying the method for forming a shallow trench in the substrate (claim 9), wherein the method is also applied (at Figs 15A-15E) for forming a gate electrode (claim 10).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to apply the method of Chen for removing residues during the formation of a shallow trench in the substrate and during the formation of a gate electrode, as taught by Verhaverbeke. This is because of the desirability to eliminate unwanted residues from the substrate so that a high quality integrated device can be manufactured in a reliable manner.

### ***Response to Amendment***

9. Applicant's remarks filed October 20, 2005 have been fully considered but they are moot in view of the new ground(s) of rejection.

After oxygen ashing to remove the patterned photoresist layer, cleaning to remove a residue from the opening by performing a halogen containing plasma is clearly taught by Yeh (6,207,565), at column 6, lines 56 through column 7; Fig 9; column 2, lines 38-54; and column 1, lines 35-53, and would have been obvious to one of ordinary skill in the art because of the desirability to clean and remove residues from the substrate, and because of the desirability to prepare a semiconductor substrate which does not allow residues to become trapped on the semiconductor substrate so that other subsequent processes can be surely carried out in a reliable manner, thereby a high quality semiconductor device can be effectively manufactured.



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Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.

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Any inquiry concerning this communication or earlier communications from the examiner should be directed to Michael M. Trinh whose telephone number is (571) 272-1847. The examiner can normally be reached on M-F: 9:00 Am to 5:30 Pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Zandra Smith can be reached on (571) 272-2429. The central fax phone number is (703) 872-9306.

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Oacs-9

  
Michael Trinh  
Primary Examiner